Article

The Six-Month Outcome of Hypertensive Crises in Relation to Risk Factors

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The Six-Month Outcome of Hypertensive Crises in Relation to Risk Factors

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Abstract: Aim To explore the impact of cardiovascular risk factors on the type and outcome of hypertensive crises. Additionally, to investigate the occurrence of new cardiovascular events in a six-month period for both types of hypertensive crises and to define possible risk factors that may influence this. **Method** The data from the hospital electronic medical records of patients who presented with hypertensive crises at the Emergency Medicine Clinic of the Clinical Center of the University of Sarajevo over a six-month period were retrospectively collected. Pregnant women were excluded. Patients who died before completing the diagnostic examination as well as patients with incomplete data were also excluded. Data collection encompassed blood pressure levels, age, sex, history of chronic hypertension, smoking status, and presence of diabetes mellitus as cardiovascular risk factors. Outcomes after initial admission and after 6 months follow up were recorded. **Results** The study included 243 patients: 66 (27.2%) with hypertensive emergencies and 177 (72.8%) with hypertensive urgencies. There was no significant difference between these groups in age, history of chronic hypertension, presence of dyslipidemia, smoking status, and presence of diabetes mellitus ($p>0.05$). Men predominated in HE, while women predominated in HU group ($p<0.05$). Diastolic blood pressure values were higher in HE patients ($p<0.05$). 98.3% of HU patients were discharged, while 92.4% of HE patients were hospitalized. Mortality after initial admission was 3%, all of whom were hypertensive emergencies. After a 6-month follow-up, there was no significant difference in the number of readmissions between these two groups ($p>0.05$), but mortality was significantly higher in hypertensive emergencies (15.15% vs 6.21%) ($p<0.05$). There was no significant difference in the investigated risk factors between patients without readmissions, with readmissions without fatal outcomes, and deceased patients ($p>0.05$) except for age, which was significantly higher in patients with fatal outcomes ($p<0.05$). **Conclusion** Male sex and higher diastolic blood pressure (DBP) are identified as risk factors for hypertensive emergency (HE), suggesting a higher likelihood of hospital treatment and increased intrahospital mortality. Patients with HE also exhibit a higher risk of a lethal outcome within six months. Advanced age is associated with an increased risk of six-month readmission and a lethal outcome.

Keywords: hypertensive crises; risk factors; outcome

Introduction

A hypertensive crisis is characterized by a state of acutely elevated blood pressure (>180 systolic / 110 diastolic), necessitating prompt medical intervention to prevent serious consequences and potential death [1]. It can arise as a consequence of uncontrolled chronic hypertension or manifest suddenly in previously healthy individuals [2]. Hypertensive crises are classified into two types: hypertensive urgency (HU), characterized by the absence of hypertensive mediated organ damage (HMOD), and hypertensive emergency (HE), characterized by its presence. Treatment recommendations differ as HU is considered milder and less dangerous, often requiring ambulance-administered blood pressure reduction, whereas HE typically necessitates hospitalization [3]. This patient categorization is a one-time assessment conducted during admission to the medical ambulance, aiming to aid physicians in decision-making. The reasons why acute hypertension leads

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to organ damage in some individuals and not in others remain unclear. Are there factors influencing the outcome of an acute hypertensive crisis? Moreover, it's uncertain whether the type of hypertensive crisis affects the likelihood of future cardiovascular events. Should patients with HE be more concerned than those with HU? If so, is it due to the potential risk factors they are exposed to? There is a scarcity of studies examining the impact of cardiovascular risk factors on the outcome of hypertensive crises, either immediately or after a certain follow-up period.

Methods

This retrospective study included patients aged 18 years or older with systolic blood pressure (SBP) ≥180 mmHg and/or diastolic blood pressure (DBP) ≥110 mmHg, who were admitted to the Clinic of Emergency Medicine, Clinical Center of the University of Sarajevo over a six-month period. Data were collected from hospital electronic patient records, with pregnant women being excluded from the study. Patients who died before completing the diagnostic examination or determining the presence/absence of hypertensive mediated organ damage (HMOD), which distinguishes hypertensive emergency (HE) from hypertensive urgency (HU), as well as patients with incomplete data regarding risk factors or other relevant information, were also excluded.

Data collection encompassed not only blood pressure levels, diagnostic results, and outcomes but also cardiovascular risk factors such as age, sex, history of chronic hypertension, dyslipidemia, smoking status, and presence of diabetes mellitus. The outcomes after admission were categorized into discharge after ambulance treatment, discharge after hospitalization, and death (either during ambulance transport or hospitalization).

A six-month follow-up involved collecting all medical records from the electronic medical registry during this period. We documented occurrences of new hypertensive crises, cardiovascular events, and cardiovascular-caused deaths, while excluding patients who died from other causes. The final six-month outcomes were classified into the following categories: absence of new events and recurrent emergency department (ED) or hospital admissions, recurrent hypertensive crises and/or other cardiovascular events, and death. As this was a retrospective non-interventional observational study, patients who died soon after the initial recorded admission (considered the primary outcome) were included in the six-month outcome analysis to present the overall outcome from the time of admission to the ED ambulance until six months afterward (considered the final outcome).

Statistical Analysis

All data were analyzed and graphically presented using the IBM SPSS 20 software. The Shapiro-Wilk test was utilized to assess the normality of distribution for continuous variables. Descriptive statistics, including counts, percentages, medians, and interquartile ranges, were employed. Categorical data were compared using the chi-square test, while non-normally distributed data were analyzed using non-parametric methods such as the Kruskal-Wallis test for multiple independent data and the Mann-Whitney test for two independent data groups. A significance level of $p > 0.05$ was considered statistically significant.

Results

The study included 243 patients: 66 (27.2%) with hypertensive emergencies and 177 (72.8%) with hypertensive urgencies. Hypertensive mediated organ damage (HMOD) in hypertensive emergencies presented as ischemic/haemorrhagic stroke in 25 cases (37.8%), acute coronary syndrome in 18 cases (27.3%), heart failure/pulmonary edema in 15 cases (22.7%), acute aortic syndrome in 4 cases (6.1%), and other conditions in 4 cases (6.1%). The median values of systolic/diastolic pressure in the observed patients were 190 (IQR 30) / 100 (IQR 10). Both groups had similar values except for the diastolic pressure in hypertensive emergencies, which was significantly higher with a median value of 110 (IQR 20) ($p<0.05$).

Analysis of risk factors showed a similar number of men (49.4%) and women (50.6%) in the overall sample, but there was a statistically significant predominance of men (68.2%) in hypertensive

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emergencies and women (57.6%) in hypertensive urgencies (p<0.05). The median age of the overall sample was 66 (IQR 15), and there was no statistically significant difference in age between patients with hypertensive urgencies and emergencies (p>0.05). Among all observed patients, 29.6% were smokers, 18.5% had diabetes mellitus, and 81.1% had a history of previous chronic hypertension. There was no statistically significant difference between patients with hypertensive urgencies and emergencies regarding the frequency of each of these three risk factors (p>0.05). The median blood pressure levels of the overall sample were 190 (IQR 30) / 100 (IQR 10). Patients with hypertensive urgencies and emergencies did not statistically differ according to systolic blood pressure levels, but those with hypertensive emergencies had significantly higher diastolic blood pressure levels. Dyslipidemia was present in 39.5% of all patients without significant differences between the groups. The results are summarized in Table 1.

Table 1. Presentation of Risk Factors in Hypertensive Crisis Patients.

	Total (N=243)	Hypertensive Emergencies (N=66)	Hypertensive Urgencies (N=177)	p-value
Male sex [N (%)]	120 (49.4)	45 (68.2)	75 (42.4)	0.000*
Female sex [N (%)]	123 (50.6)	21 (31.8)	102 (57.6)	
Age [Median (IQR)]	66 (15)	65 (12)	66 (15)	0.577**
Chronic hypertension (N)	197 (81.1)	46 (69.7)	151 (85.3)	0.006*
Systolic blood pressure [Median (IQR)]	190 (30)	190 (43)	190 (30)	0.083**
Diastolic blood pressure [Median (IQR)]	100 (10)	110 (20)	100 (10)	0.002**
Dyslipidemia [N (%)]	96 (39.5)	22 (33.3)	74 (41.8)	0.229*
History of smoking [N (%)]	72 (29.6)	15 (22.7)	57 (32.2)	0.150*
History of diabetes [N (%)]	45 (18.5)	13 (19.7)	32 (18.1)	0.773*

*Chi square test; **Mann-Whitney test.

The vast majority of HU patients (98.3%) were discharged after ambulance treatment, with only 1.7% requiring hospitalization due to resistant elevated blood pressure levels without HMOD. In contrast, and understandably so, the majority of HE patients (92.4%) were hospitalized and discharged after successful treatment, while 3% succumbed to their condition in the hospital. Although HMOD is significant for these patients, there were still 4.5% of discharged patients due to a milder form of the disease or refusal of hospitalization.

After a six-month follow-up, we discovered that 65% of patients experienced no complications. Both HU and HE patients [had a similar percentage of individuals without readmission to medical services (63.3% and 69.7% respectively). In total, there were 93 recorded readmissions, with 9 patients experiencing two readmissions and 3 patients having three readmissions. Among these readmissions 30 were hypertensive crises with or without organ damage, accounting for 32.3% of all readmissions. The clinical presentation of readmissions is detailed in Table 2.

Table 2. Clinical Presentation of Readmissions.

Readmission Diagnosis	Number (N)	Percentage (%)
Hypertensive crisis with or without organ damage	30	32.3
Transitory cerebrovascular ischaemia	25	26.9
Cerebrovascular stroke	10	10.8
Myocardial infarction	4	4.3
Angina pectoris	21	22.6
Heart failure/pulmonary edema	5	5.4
Other	6	6.5

* The number of diagnoses does not match the number of patients or readmissions because some patients had two or more diagnoses at readmission. Percentages are related to the total number of readmissions (N=93).

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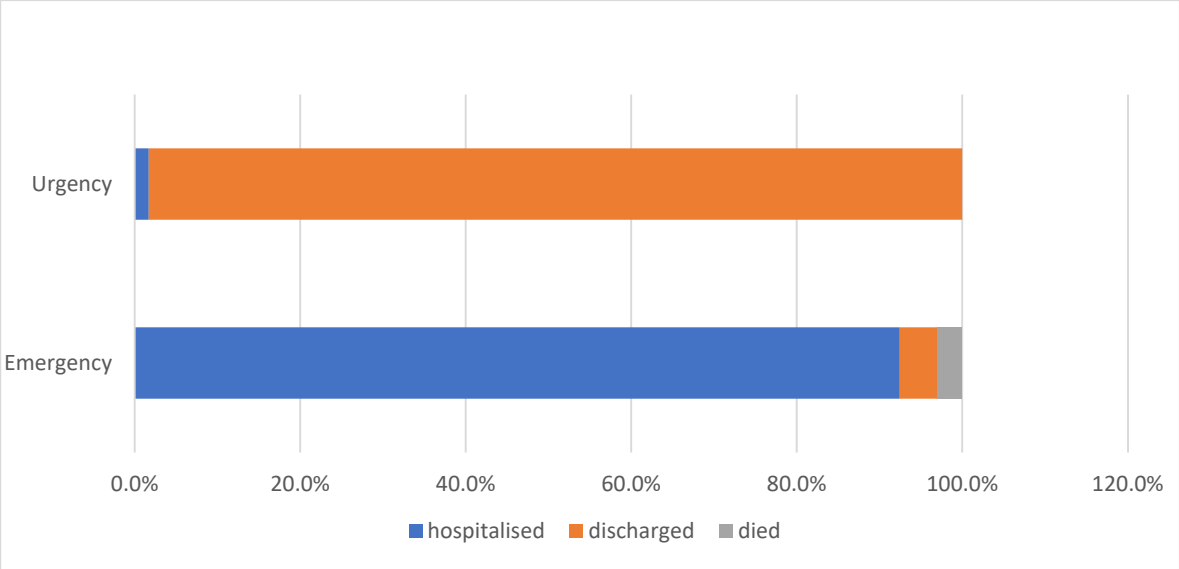

Figure 1. Outcome of the initial admission.

The HU group exhibited a 30.51% rate of non-fatal complications and a 6.21% rate of fatal complications, while the HE group had identical percentages of 15.15% each (p=0.011). These results are depicted in Figure 2, which illustrates the outcomes of patients from the initial admission to the six-month follow-up period.

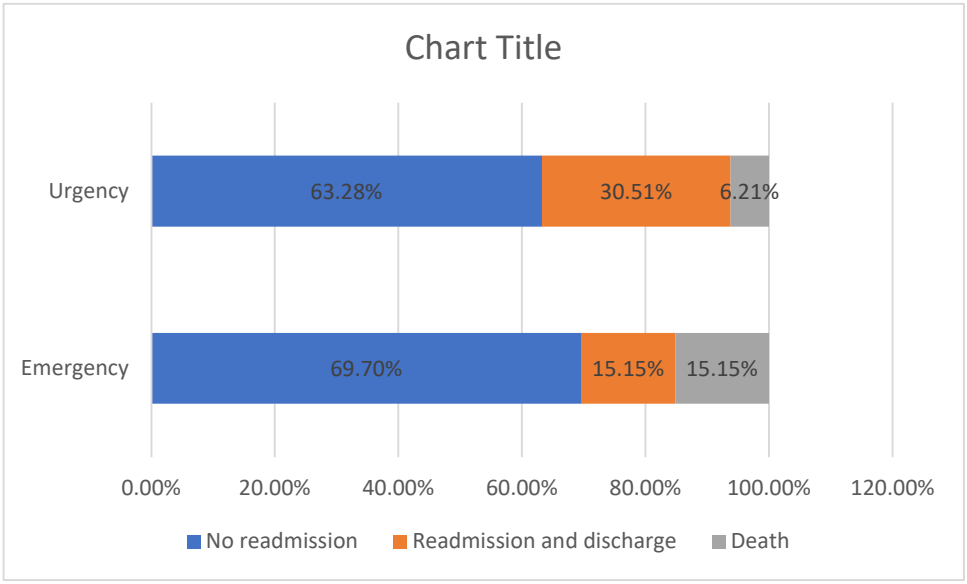

Figure 2. Six months outcome.

The mortality rate of HE patients was 15.15%, with 3% of patients succumbing during the initial admission, resulting in a 12.15% mortality rate for subsequent readmissions. Conversely, all HU patients survived after the initial admission, yielding a mortality rate of 6.21% for readmissions. Figure 2 displays the outcomes of patients from the initial admission to the six-month follow-up period.

An analysis of the impact of risk factors on the six-month outcome revealed no statistically significant difference in the number of male/female patients, those with a history of chronic hypertension, smokers, and patients with diabetes mellitus between the groups of hypertensive crisis patients without complications, with non-fatal complications, and with fatal complications (p>0.05).

 doi:10.20944/preprints202404.1850.v1

However, age was significantly higher in patients with complications during the six-month period (p=0.000). The results are presented in Table 2.

Table 3. Presentation of risk factors and 6 months outcome.

	No Readmission (N=158)	Readmission and Discharge (N=64)	Death (N=21)*	P Value
Emergency [N (%)]	46 (29.1)	10 (15.6)	10 (47.6)	0.011
Urgency [N (%)]	112 (70.9)	54 (84.4)	11 (52.4)	
Male Sex [N (%)]	75 (47.5)	34 (53.1)	11 (52.4)	0.717
Female Sex [N (%)]	83 (52.5)	30 (46.9)	10 (47.6)	
Age [Median (IQR)]	64 (18)	73 (13)	73 (12)	0.000
Chronic Hypertension [N (%)]	125 (79.1)	53 (82.8)	19 (90.5)	0.421
Dyslipidemia [N (%)]	63 (39.9)	24 (37.5)	9 (42.9)	0.898
Smoker [N (%)]	49 (31.0)	19 (29.7)	4 (19.0)	0.529
Diabetes [N (%)]	26 (16.5)	13 (20.3)	6 (28.6)	0.370

*Number of deaths includes those who died at the initial admission as well as at the readmission.

Discussion

The observed sample of patients showed a predominance of HU over HE cases (72.8% vs. 27.2%) consistent with clinical experience and other findings [4]. The most common presentations of HMOD in HE patients were stroke (hemorrhagic or ischemic), followed by acute coronary syndrome and heart failure/pulmonary edema, while other presentations were rare. Discrepancies in findings across studies may be attributed to differences in lifestyle, health habits, and ethnicity in the studied populations [4,5].

The frequency of observed risk factors was compared with results from other studies. The percentage of patients with existing hypertension in our research was relatively high (81%), similar to samples from other studies. There was also a predominance of patients older than 65 years in our study and others [6,7]. While we found a slight predominance of women (50.6%), some studies reported significantly higher percentages of men [7]. Additionally, the number of patients with a history of diabetes varied across different studies (6,7,8), possibly due to differences in therapy, lifestyle habits, ethnicity, and sample selection. The prevalence of smokers in our sample (29.6%) fell between the percentages reported in other studies, which could reflect differences in anti-smoking campaigns and patient reporting accuracy. Our sample also had a significant proportion of patients with dyslipidemia (39.5%), which aligns with expectations given local dietary habits though it contrasts with findings from other studies conducted in Italy [5]. Blood pressure values at admission were similar in our study compared to other reports [5,8].

Patients with HU and HE did not statistically differ in terms of smoking status, diabetes mellitus, or median age. However, there was a significant predominance of men and patients with previously verified hypertension in the HE group. This group also had significantly higher diastolic blood pressure levels. These results suggest that male sex, a history of hypertension, and higher diastolic blood pressure could be factors increasing the likelihood of hypertensive crisis leading to organ damage. However, Vallelonga et al. did not find any significant differences in risk factors between HU and HE groups, including those significant in our results [5].

The outcomes after admission were as expected. Most HU patients were discharged after ambulance treatment, although a small percentage (1.7%) required hospitalization due to difficulties in lowering blood pressure levels. The majority of HE patients with organ damage were hospitalized, with only a small number (4.5%) discharged. These discharged patients either refused hospitalization or had mild cerebrovascular incidents that did not require hospital treatment. Three percent of HE patients died either in the ambulance or during hospitalization. A recent meta-analysis by Shiddiqi et al. reported a higher in-hospital mortality rate for HE of 9% [9]. Guiga et al. also found a similar mortality rate [10]. A study investigating the outcome of hypertensive crisis patients admitted to the coronary care unit also found a higher hospital mortality rate in HE patients [11].

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Our mortality rate would likely have been higher if we had not excluded patients who died before completing data collection or diagnostic procedures. Additionally, the number of patients who died during transport to the ambulance was unknown.

The association between risk factors and outcomes after admission was not observed because most discharged patients were HU and hospitalized patients were HE, and all deceased patients had HE. This suggests that all risk factors significantly higher in the HE group (male sex, history of hypertension, higher diastolic blood pressure) could be considered enhancers of the risk for hospitalization and mortality at admission. Furthermore, patients without previously verified chronic hypertension were more likely to have their first hypertensive crisis resolve as HU without organ damage or hospital treatment.

Although the majority of patients had no complications during the six-month period after their hypertensive crisis, the results were still concerning. More than a third of patients (35%) had readmissions to medical services due to new episodes of elevated blood pressure or other cardiovascular events, ending either in discharge or death. The main cause of readmissions was new hypertensive crises, accounting for 32.3% of all readmissions. This rate is concerning compared to the 15.3% reported in a study with a much longer follow-up period [7]. Additionally, a mortality rate of 8.64% cannot be overlooked. We attempted to investigate the reasons for these results and identify possible influencing factors. Although HU and HE patients had a similar proportion of patients without readmissions to medical services, the severity of new episodes differed, as evidenced by the significantly higher mortality rate in HE compared to HU patients (12.15% vs. 6.21%, respectively). Considering that the overall mortality rate of HE patients, including those who died during the first admission, was 15.15%, we conclude that patients with HE were almost twice as likely to experience a lethal outcome. The fact that there were a similar number of HU and HE patients among the deceased, despite the HE group being much larger, further confirms this. Other studies also found higher mortality rates in HE patients [10,12,13].

Exploring the impact of risk factors on the six-month outcome, we found that only age was significantly higher in patients who had readmissions. The median age of patients without readmissions was 64, while in the other groups, it was 73 years. A trial conducted in HU patients found that age above 63 years was a risk factor for cardiovascular events [14]. In another trial, age over 65 years was a risk factor for 30-day readmission in HE patients [15]. Both groups of patients, those who died and those who survived after readmission, had a similar age profile. None of the other investigated factors (sex, dyslipidemia, history of diabetes, and chronic hypertension) could be considered risk factors for readmission. This also applied to the severity and outcome of events. Studies focused on sex-related outcomes of hypertensive crisis had contradictory results. Conclusions varied, with some studies suggesting that men [16] or women [14,15] had more cardiovascular events. However, these trials focused on only one type of hypertensive crisis (HE or HU, respectively) and had different follow-up periods.

Conclusion

Male sex and higher diastolic blood pressure (DBP) are identified as risk factors for hypertensive emergency (HE), suggesting a higher likelihood of hospital treatment and increased intrahospital mortality. Patients with HE also exhibit a higher risk of a lethal outcome within six months. Advanced age is associated with an increased risk of six-month readmission and a lethal outcome.

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